

- MAÑOSA, S. 1994. Goshawk diet in a Mediterranean area of northeastern Spain. *J. Raptor Res.* 28:84–92.
- AND P. CORDERO. 1992. Seasonal and sexual variation in the diet of the Common Buzzard in northeastern Spain. *J. Raptor Res.* 26:235–238.
- MARTÍNEZ, J.E., M. CREMADES, I. PAGÁN, AND J.F. CALVO. 2004. Diet of Booted Eagles in southeastern Spain. Pages 593–599 in R.D. Chancellor and B.-U. Meyburg [EDS.], *Raptors worldwide*. World Working Group on Birds of Prey & Owls. MMD/BirdLife, Hungary, Budapest.
- MASSEMIN, S., E. KORPIMÄKI, AND J. WIEHN. 2000. Reversed sexual size dimorphism in raptors: evaluation of the hypotheses in kestrels breeding in a temporally changing environment. *Oecologia* 124:26–32.
- MUELLER, H.C. AND K. MEYER. 1985. The evolution of reversed sexual dimorphism in size: a comparative analysis of the Falconiformes of the western Palearctic. Pages 65–101 in R.F. Johnston [ED.], *Current ornithology*. Plenum, New York, NY U.S.A.
- NEWTON, I. 1979. *Population ecology of raptors*. T. & A.D. Poyser, Berkhamsted, U.K.
- OPDAM, P. 1975. Inter- and intraspecific differentiation with respect to feeding ecology in two sympatric species of the genus *Accipiter*. *Ardea* 63:30–54.
- OVERSKAUG, K., E. KRISTIANSEN, AND P. SUNDE. 1995. Sex-specific diet analysis of the Tawny Owl (*Strix aluco*) in Norway. *J. Raptor Res.* 29:137–140.
- REYNOLDS, R.T. 1972. Sexual dimorphism in *Accipiter* hawks: a new hypothesis. *Condor* 74:191–197.
- SIMMONS, R.E. 1986. Ecological segregation of the Red-breasted Sparrowhawk *Accipiter rufiventris* and six co-existing Accipitrine raptors in southern Africa. *Ardea* 74:137–149.
- . 2000. *Harriers of the world: their behavior and ecology*. Oxford Univ. Press, Oxford, U.K.
- SNYDER, N.F.R. AND J.W. WILEY. 1976. Sexual size dimorphism in hawks and owls of North America. *Ornithol Monogr.* 20:1–96.
- STEYN, P. AND J.H. GROBLER. 1985. Supplementary observations on the breeding biology of the Booted Eagle in southern Africa. *Ostrich* 56:151–156.
- TEMELES, E. 1985. Sexual size dimorphism of bird-eating hawks: the effect of prey vulnerability. *Am. Nat.* 125:485–499.
- TOYNE, E.P. 1998. Breeding season diet of the goshawk *Accipiter gentilis* in Wales. *Ibis* 140:569–579.
- VAN DEN BRICK, F.H. AND P. BARRUEL. 1972. *Guía de campo de los mamíferos salvajes de Europa occidental*. Omega, Barcelona, Spain.
- VEIGA, J.P. 1986. Food of the Booted Eagle (*Hieraaetus pennatus*) in central Spain. *Raptor Res.* 20:120–123.
- AND J. VIÑUELA. 1994. Booted Eagle *Hieraaetus pennatus*. Pages 182–183 in G.M. Tucker and M.F. Heath [EDS.], *Birds in Europe: their conservation status*. BirdLife International, Cambridge, U.K.
- VENABLES, B.D. AND W.N. RIPLEY. 2002. *Modern applied statistics with S*, 4th Ed. Springer, New York, NY U.S.A.
- VILLARÁN, A. 2000. Análisis comparativo de la dieta de ambos sexos en el cárabo común *Strix aluco* en la Península Ibérica. *Ardeola* 47:203–213.
- WIDÉN, P. 1984. Activity patterns and time budgets in the goshawk *Accipiter gentilis* in a boreal forest area of central Sweden. *Ornis Fenn.* 61:109–112.

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PREDATION OF SMALL MAMMALS BY RUFIOUS-LEGGED OWL, BARN OWL, AND MAGELLANIC HORNED OWL IN ARGENTINEAN PATAGONIA FORESTS

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KEY WORDS: *Magellanic Horned Owl*; *Bubo magellanicus*; *Rufous-legged Owl*; *Strix rufipes*; *Barn Owl*; *Tyto alba*; *diet*; *sigmodontine rodents*.

Despite the large number of forest owls in the Neotropics, there are few data available on their diets that

reflect foraging inside forested habitats. For the southern cone of South America, including Argentina and Chile, only a few contributions have addressed this topic (Martínez and Jaksic 1996, 1997, Ramírez-Llorens 2003, Trejo and Ojeda 2004).

The Rufous-legged Owl (*Strix rufipes*) inhabits dense and old-growth temperate forests in southern Argentina and Chile (Straneck and Vidoz 1995, Martínez and Jaksic

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Table 1. Number and percent frequency of prey items and proportion of scansorial (SC), arboreal (AR), cursorial (C), and fossorial (S) small mammals in the three analyzed owl pellet samples from Argentinean Patagonia forest. Percent frequency is in parentheses.

RODENTS	MAGELLANIC HORNED OWL	RUFIOUS-LEGGED OWL	BARN OWL
<i>Abrothrix longipilis</i> (C)	—	7 (6.9)	6 (7.2)
<i>Abrothrix olivaceus</i> (C)	—	36 (35.6)	11 (13.3)
<i>Chelemys macronyx</i> (S)	9 (27.3)	1 (1.0)	—
<i>Elagmodontia morgani</i> (C)	4 (12.1)	—	—
<i>Geoxus valdivianus</i> (S)	—	2 (2.0)	1 (1.2)
<i>Irenomys tarsalis</i> (AR)	—	7 (6.9)	6 (7.2)
<i>Loxodontomys micropus</i> (C)	20 (60.6)	19 (18.8)	21 (25.3)
<i>Oligoryzomys longicaudatus</i> (SC)	—	29 (28.7)	38 (45.8)
Total	33	101	83
SC and AR (%)	—	35.6	48.2
C and S (%)	100	64.4	51.8

1996, 1997). Diet information about this owl is only known from few localities in Chile (Martínez and Jaksic 1996, 1997, Diaz 1999). The Barn Owl (*Tyto alba*) and the Magellanic Horned Owl (*Bubo magellanicus*; del Hoyo et al. 1994) are widespread in South America and numerous contributions have described their diets (Pardiñas and Cirignoli 2002 and references therein). However, these works focused on pellet samples from open areas; consequently, the knowledge of owl predation in forested habitats is extremely limited. The only available data for the Barn Owl in a forested habitat were reported by Trejo and Ojeda (2004) on the basis of an owl pellet sample recovered in Nahuel Huapi Forest (Argentina).

Here, we report the first data on the diet of the Rufous-legged Owl in Argentina and the Magellanic Horned Owl in forested landscapes. In addition, we present information about the small mammals preyed upon by the Barn Owl in Patagonian forests.

STUDY AREA AND METHODS

Owl pellet samples were collected in three localities of Neuquén and Río Negro provinces (Argentina): Magellanic Horned Owl (18 pellets), Las Breñas Ranch (39°30'S, 71°02'W, 1437 m elevation, Neuquén); Rufous-legged Owl (43 pellets), Lago Steffen (41°32'S, 71°35'W, 730 m, Río Negro); and Barn Owl (36 pellets), Cacique Foyel Ranch, Alto Río Villegas (41°35'S, 71°31'W, 700 m, Río Negro).

Las Breñas Ranch is located in the Pehuen district, Subantarctic phytogeographic province (Cabrera 1971). This environment is found between 900–1800 m and is dominated by forests of pehuen (*Araucaria araucana*) associated with lenga (*Nothofagus pumilio*) and coligüe cane (*Chusquea culeou*). Lago Steffen and Cacique Foyel Ranch are located in the Caducifolious Forest district (subantarctic phytogeographic province; Cabrera 1971) and are characterized by the presence of ñire and coihue (*Nothofagus antarctica*, *N. dombeyi*), lenga, and ciprés (*Austrocedrus chilensis*).

Osteological remains were picked apart by hand and

prey were identified by comparison with the reference mammal collection of the Centro Nacional Patagónico, Puerto Madryn, Argentina, and identification keys (Pearson 1995). The taxonomic criteria follow Galliari et al (1996). The minimum number of mammal prey items was estimated by counting mandibles. The Rufous-legged Owl sample was previously analyzed by O. Pearson (field notes 1982) and kindly provided to U. Pardiñas for inclusion here.

RESULTS AND DISCUSSION

We recovered 217 prey items, exclusively sigmodontine rodents, from the examined pellets (Table 1). Only three species were eaten by the Magellanic Horned Owl; most of which was the austral greater mouse (*Loxodontomys micropus*). The Rufous-legged Owl and Barn Owl consumed seven and six species, respectively. Both owls preyed upon the same small mammal assemblage, primarily consuming the olivaceous field mouse (*Abrothrix olivaceus*), the long-tailed mouse (*Oligoryzomys longicaudatus*), and the austral greater mouse. Diet of Magellanic Horned Owl differed from that of Rufous-legged Owl and Barn Owl in the proportion and kind of small mammal species found in pellets (Table 1). These differences may be attributed to the specific forest areas where these respective owls foraged (see Study Area and Methods).

Despite the small pellet samples examined, we registered almost exclusively small mammals related to forested or bushy-forested cover types (Pearson 1995). The austral greater mouse, heavily preyed upon by the three owls studied, was a common sigmodontine in dense ñire-bushy and coligüe cane formations. The same is true for the long-tailed mouse and the olivaceous field mouse, main prey items in the diets of the Rufous-legged Owl and the Barn Owl. In addition, these owls consumed the poorly known (in Argentina) Chilean tree rat (*Irenomys tarsalis*), a specialist of *Nothofagus* forests (Kelt 1993). The dominance of forest species in the diet of the Rufous-

legged Owl and Barn Owl suggests that these owls hunted within the forest. This fact is reinforced by the absence of those species characteristic of open areas, like the Patagonian leaf-eared mouse (*Phyllotis xanthopygus*), the rabbit rat (*Reithrodon auritus*), the silky rat (*Euneomys chinilloides*), and the southern cavy (*Microcavia australis*). The same is true for the Magellanic Horned Owl, although we cannot discard the possibility of forest-steppe ecotone hunting by these raptors.

The olivaceous field mouse constituted a high proportion of the Rufous-legged and Barn Owl diets, being the dominant prey in the diet of the former. These results contrast with those of Trejo and Ojeda (2004) and Martínez and Jaksic (1997), who reported a low consumption and an apparent avoidance of this species by the owls, despite its high abundance in the field. Martínez and Jaksic (1997), working with the Rufous-legged Owl in Chile, mentioned the preference of this owl for arboreal and scansorial small mammals (e.g., *Dromiciops gliroides*, *Irenomys tarsalis*, *Oligoryzomys longicaudatus*) over cursorial ones (e.g., *Abrothrix olivaceus*, *A. longipilis*). These authors proposed that different escape tactics or detectability of cursorial species in addition to the sit-and-wait predation strategy of the Rufous-legged Owl as an explanation for the high representation of arboreal and scansorial species in the owl's diet. In contrast, our data showed that, at least in the study area, this owl preyed upon cursorial and fossorial rodents (64.4%) over arboreal and scansorial species (35.6%; Table 1). This fact could be related to the presence of small open areas (gaps) in the forest, where the cursorial rodents could be more detectable. These results were in agreement with Diaz (1999) who observed a preference of Rufous-legged Owl for terrestrial prey in the Mediterranean sclerophyllous forest of central Chile.

In spite of the low number of pellets analyzed for Magellanic Horned Owl, the results suggested that this species took exclusively cursorial and fossorial rodents associated with dense vegetative cover. This finding demonstrated the capability of this owl hunting inside the forest, although it may be foraging mostly in open patches. This agrees with Teta et al. (2001) who proposed that horned owls preferentially consumed open-area species rather than arboreal and scansorial ones, as a result of its sit-and-wait hunting strategy (Marti 1974).

The scarce number of forested sites studied in southern South America may be attributed mainly to the difficulty of identifying owl roosts coupled with a low preservation rate of pellets in humid forest environments.

DEPREDACIÓN DE MAMÍFEROS PEQUEÑOS POR *STRIX RUFIPES*, *TYTO ALBA* Y *BUBO MAGELLANICUS* EN BOSQUES PATAGÓNICOS DE ARGENTINA

RESUMEN.—Se estudiaron los mamíferos depredados por *Bubo magellanicus*, *Strix rufipes* y *Tyto alba* en tres localidades boscosas de las provincias de Neuquén y Río Ne-

gro. Sobre un total de 217 presas (exclusivamente roedores sigmodontinos), *Oligoryzomys longicaudatus*, *Loxodontomys micropus* y *Abrothrix olivaceus* fueron los más consumidos. Estos resultados, sumados a la baja o nula frecuencia de especies de micromamíferos de áreas abiertas, sugieren que las tres rapaces estudiadas cazaron en el interior del bosque. Este es el primer estudio de dieta para *S. rufipes* en Argentina y para *B. magellanicus* en el bosque patagónico.

[Traducción de los autores]

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LITERATURE CITED

- CABRERA, A. L. 1971. Fitogeografía de la República Argentina. *Bol. Soc. Argent. Bot.* 14:1–43.
- DEL HOYO, J., A. ELLIOTT, AND J. SARGATAL. 1994. Handbook of the birds of the world, Vol. 2. Lynx Edicions, Barcelona, Spain.
- DIAZ, I. 1999. Food habits of the Rufous-legged Owl (*Strix rufipes*) in the Mediterranean sclerophyllous forest of central Chile. *J. Raptor Res.* 33:260–264.
- GALLIARI, C., U.F.J. PARDIÑAS, AND F. GOIN. 1996. Lista comentada de los mamíferos Argentinos. *Mastozool. Neotrop.* 3:39–61.
- KELT, D.A. 1993. *Irenomys tarsalis*. *Mamm. Species* 447:1–3.
- MARTI, C.A. 1974. Feeding ecology of four sympatric owls. *Condor* 76:45–61.
- MARTÍNEZ, D.R. AND F.M. JAKSIC. 1996. Habitat, relative abundance, and diet of Rufous-legged Owls (*Strix rufipes* King) in temperate forest remnants of southern Chile. *Ecoscience* 3:259–263.
- AND ———. 1997. Selective predation on scansorial and arboreal mammals by Rufous-legged Owls (*Strix rufipes*) in southern Chilean rainforest. *J. Raptor Res.* 31:370–375.
- PARDIÑAS, U.F.J. AND S. CIRIGNOLI. 2002. Bibliografía comentada sobre los análisis de egagrópilas de aves rapaces en Argentina. *Ornitol. Neotrop.* 13:31–59.
- PEARSON, O.P. 1995. Annotated keys for identifying small mammals living in or near Nahuel Huapi National Park or Lanín National Park, southern Argentina. *Mastozool. Neotrop.* 2:99–148.
- RAMÍREZ LLORENS, P.M. 2003. Ecología trófica de Strigiformes en Argentina: *Pulsatrix perspicillata* (Lechuzón Mocho Grande). M.S. thesis, Univ. Nacional Buenos Aires, Buenos Aires, Argentina.
- STRANECK, R.J. AND F. VIDOZ. 1995. Sobre el estado taxonómico de *Strix rufipes* (King) y de *Strix chacoensis* (Cherrie and Reichenberger). *Nót. Fauníst.* 74:1–5.

TETA, P., C. PANTI, A. ANDRADE, AND A. PEREZ. 2001. Amplitud y composición de la dieta de *Bubo virginianus* (Aves, Strigiformes, Strigidae) en la Patagonia noroccidental Argentina. *Bol. Soc. Biol. Concep.* 72:125–132.

TREJO, A. AND V. OJEDA. 2004. Diet of Barn Owl (*Tyto*

alba) in forested habitats of northwestern Argentine Patagonia. *Ornitol. Neotrop.* 15:1–5.

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CHANGES IN SITE OCCUPANCY AND NESTING PERFORMANCE OF PEREGRINE FALCONS IN COLORADO, 1963–2004

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KEY WORDS: *Peregrine Falcon*; *Falco peregrinus*; *occupancy rate*; *population change*; *productivity*; *reproductive success*; *Colorado*.

In 1965, Professor Joe Hickey held a conference of more than 50 people at the University of Wisconsin to review marked declines of several species of bird-eating and fish-eating raptors, particularly the Peregrine Falcon (*Falco peregrinus*; Hickey 1969). By that time, peregrines were extirpated in parts of Europe and the eastern United States and were greatly reduced in several other regions. The purpose of this paper is to compare territory occupancy and nesting performance in Colorado in the 1960s and 1970s, when the population was in decline, with falcon activities and occupancy at most of the same cliffs in 2004.

In 1964, a broad survey in the Rocky Mountain region was accomplished (Enderson 1965) and adult pairs in Colorado were present at five (33%) of 15 cliffs visited. Single peregrines were seen at two other sites, and eight were apparently vacant; only four young were seen at these sites. Another survey was done in Colorado in 1973 and the results were included in a broader regional report (Enderson and Craig 1974); eight (44%) pairs were found at 18 sites and only two young were seen. These published reports included records from only a single year. Because additional unpublished data are available for Colorado in other years during those early periods, it would be useful to include them in a wider analysis and to contrast those historical results with a recent survey that I completed in 2004.

METHODS

In the period from 1963–65, I visited cliffs in Colorado where peregrines had been reported in the literature or

gleaned from correspondence with interested people, often falconers. I also visited several sites in the 1973–75 period that included most of the territories from the earlier survey plus two additional peregrine cliffs found in the interim. The sites visited in 2004 included 15 sites selected arbitrarily from those included in the earlier survey periods. In all, 21 different sites were surveyed at least once in the three periods.

In 2004, I also visited an additional 32 sites found since 1975. I did not include the latter group in the activity and occupancy comparisons between periods. The additional 32 cliffs were checked because they were logistically accessible while I visited historical sites, or were reported by other observers. They were selected without regard for past occupancy or reproductive performance.

Because of small sample size in any one year, I pooled data within the first two periods. As a result, data for as many as three seasons within a period were tallied for some locations. For this analysis, reproductive performance by pairs between years at the same site was considered independent, but the validity of that notion was not tested.

A spotting scope or binoculars on a tripod or window mount were used to discover falcons on cliffs. In the two earlier periods, I usually walked the tops of the cliffs in addition to the distant viewing. Unless weather interfered, I usually searched the cliff for at least 4 hr or until peregrines were seen. Incubation, brooding, or food exchanges usually occurred in that span of time. When fresh excrement was seen, or poor weather interrupted, searching was extended or often repeated on another day. Sites were excluded from the analysis if I assessed that sampling was inadequate to determine occupancy. I believe the effectiveness of observations was generally similar between periods, except that in 1963–65 when I was less familiar with the cliffs and peregrine activities at the cliffs. Sites were usually visited once or twice to verify occupancy, and usually once to count young. This pattern did not change substantially between periods, except that in the first two periods I often checked, based on incubation behavior, to see if females had laid eggs as well.

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